Children Exposed

Biomonitoring Can Provide a Baseline

A 1993 report by the National Academy of Sciences suggested that pesticide safety thresholds should be lower for children than for adults—up to 10 times lower—due to children's generally higher vulnerability to the effects of certain compounds. In a controversial response to this report, the U.S. Environmental Protection Agency (EPA) determined that, as part of its implementation of the Food Quality Protection Act (FQPA), which mandates evaluation of aggregate exposure to pesticides and cumulative health risk, it must reassess nearly 10,000 uses for hundreds of pesticides.

Among the first pesticides to be reassessed are the widely used organophosphate compounds. Gauging children's aggregate exposure to those pesticides and their cumulative risk is a tremendous task. In this issue, Richard Fenske and colleagues at Seattle's University of Washington School of Public Health and Community Medicine tested biological monitoring as a means of meeting this challenge [*EHP* **108:515–520**]. They found that such biomonitoring can indeed be useful in performing this task, and may also be helpful in setting baselines for regulatory use.

Current methods for assessing aggregate exposure rely on complex modeling and measurement of environmental concentrations, such as pesticide concentrations in food, drinking water, and household dust. Using models, researchers then factor in behavioral information such as food or water intake, or contact with dust. Conducting such assessments for each exposure route and pathway becomes very complex and uncertain. Fenske and colleagues maintain that biological monitoring (for example, a series of urine analysis measurements to detect pesticide metabolites) accounts for all routes and pathways of exposure with a single measurement or a series of measurements. Organophosphate pesticides, which are metabolized relatively quickly and excreted in the urine, are prime candidates for biological monitoring.

The fruits of biomonitoring. Studies done on children who live near apple orchards where organophosphate pesticides were sprayed show that biomonitoring may be a useful tool for gauging children's exposures to pesticides.

The researchers obtained two urine samples each from 109 children (up to six years old) around Wenatchee, Washington, during the May–July period when apple orchards in the area are sprayed with organophosphate pesticides. Ninety-one "case" children came from households with adults engaged in field-based agriculture, and 18 "control" children came from households with no field-based workers. One child from each household (62 cases, 14 controls) was then selected for statistical analysis.

The researchers measured metabolite concentrations using gas chromatography and found significant amounts of two organophosphate compounds, dimethyl thiophosphate and dimethyl dithiophosphate. Based on metabolite concentrations, they were able to back-calculate how much pesticide each child was exposed to. An average of the pesticide metabolites in each child's two samples provided a "spray season dose," considered a best estimate of daily exposure. Metabolite concentrations were then converted to dose values.

The researchers then compared the children's dose estimates to reference dose values (benchmark concentrations at which a pesticide can be chronically ingested with no observable adverse effects) developed by the EPA and the World Health Organization for azinphos-methyl and phosmet, the primary organophosphate pesticides then used in the region. For azinphos-methyl, 56% of the case children's doses and 44% of the control children's doses exceeded the EPA's reference dose values. For phosmet, 9% of the case children's doses and none of the control children's doses exceeded the reference dose value. If the current EPA reference doses for the two pesticides were increased by 10-fold, as recommended by the FQPA to provide a child safety factor for certain pesticide risk assessments, those limits would have been exceeded by most of the children with detectable metabolites in this study.

The authors conclude that organophosphate pesticide exposures for children in agricultural communities fall into a range that merits regulatory concern. They further conclude that biological monitoring can help regulators evaluate aggregate exposure and cumulative risk, as mandated by the FQPA. Biomonitoring surveys of selected child populations at an early stage of FQPA implementation could provide important baseline data for the big task of evaluating the law's effectiveness. **–David A. Taylor**